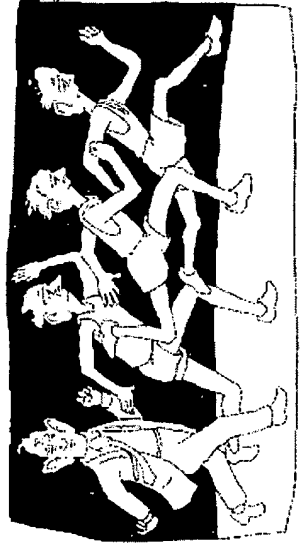




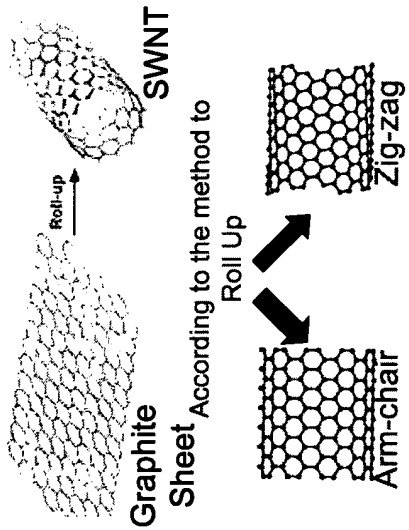
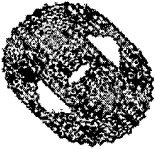
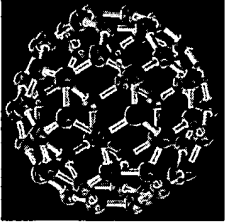
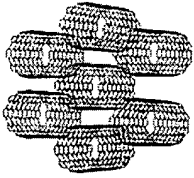
Differences between the invention and the references cited

2005.5.14

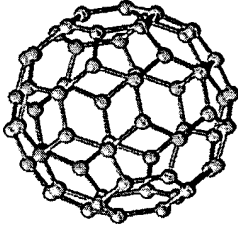
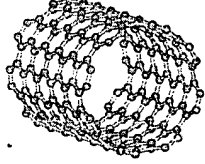
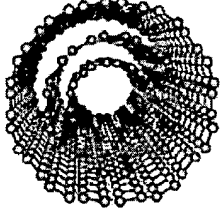
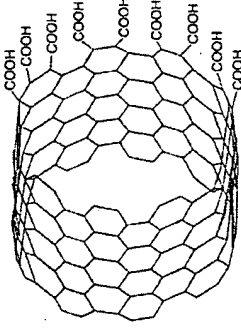
Jong Jin PARK



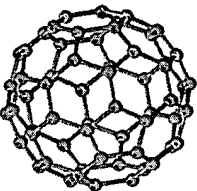
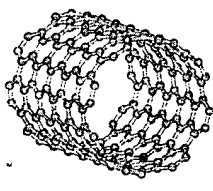
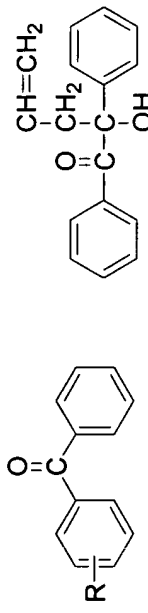
Properties of Carbon nanotube

type	structure	Physical properties
Single Wall		<p>Size : 1000 times as small as commercial Carbon or Glass Fiber (CNT: $\phi 1.4\text{nm}$)</p> <p>Electrical aspect : having Band Gaps properties. -> Semi-conductive properties</p> <p>Mechanical aspect : High Aspect Ratio > 1000 (Max. 100μm synthesizable) Outstanding Strength</p> <p>Conductivity : having metallic properties because of high electric and thermal conductivities.</p>
Multi-Wall	 <p>Rolled-up with several sheets</p>	<p>Organic compound like a ball composed of carbon only :Buckyball</p> 
Rope	 <p>Formed of rope of SW and MW</p>	<p>Function as electrical superconductor to insulator, depending on their combining structure.</p>

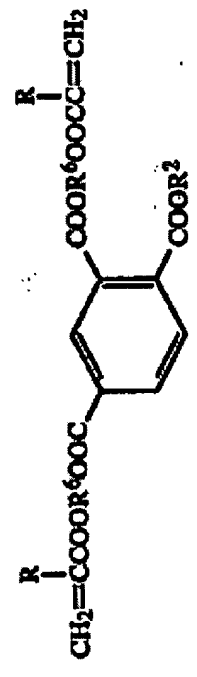
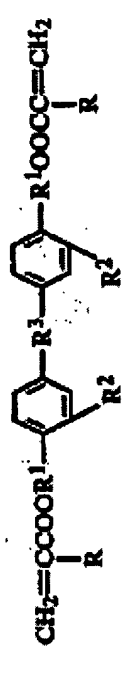
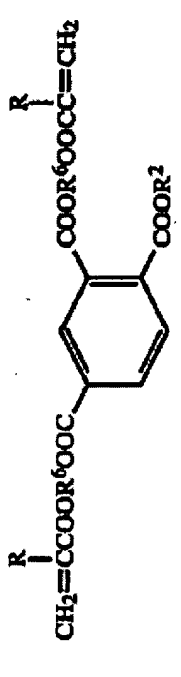
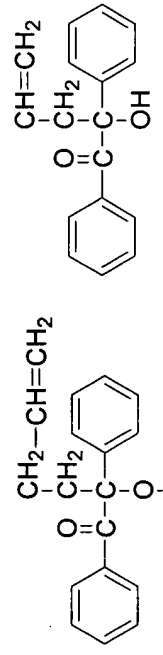
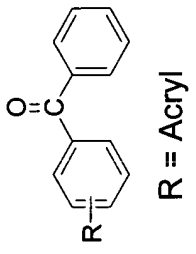
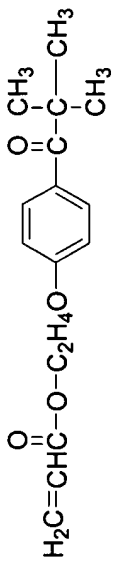
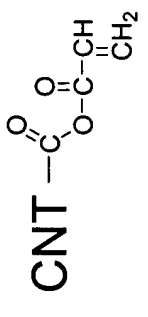
Comparison of C₆₀ (Fullerene) with Carbon Nanotube

	Fullerene C ₆₀	CNT
Structure	 <p>Ball Type of Carbon allotrope</p>	<div>  <p>Single wall</p> </div> <div>  <p>Multi wall</p> </div> <p>Nanotube</p>
Surface treatment	<p>Addition reaction</p> <p><i>Chem. Rev.</i>; 1992; 92(7); 1487-1508.</p>	<p>Scission by acid reaction</p> <div>  <p>Acid functionalized and shortened by sonicating in a mixture (7:3) of HNO₃ and H₂SO₄</p> </div> <ul style="list-style-type: none"> -scission occurs preferably at both sides with COOH result in oxidation - cut SWNTs into many short pieces. - broad distribution of opened-ended SWNTs.

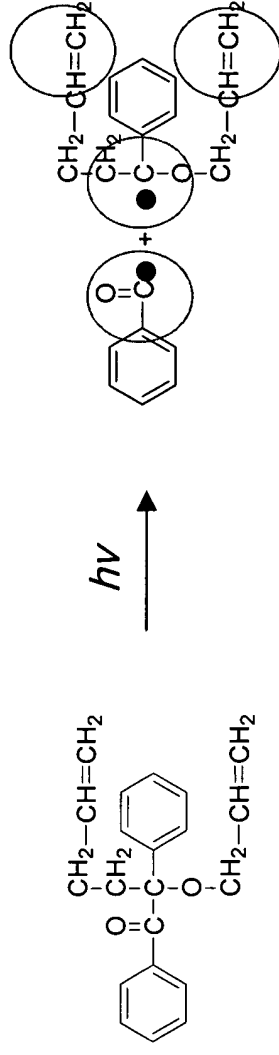
Comparison of US 5,561,026 with 10/713,254

	US 5,561,026	10/713,254
Surface modification	<p>Addition reaction</p>  <p>+ Alkyl amine or Azido compounds</p> <p>+ Methacrylchloride</p> <p> $\text{C60} - \text{NCH}_2\text{CH}_2\text{CH}_3$ $\quad \quad \quad \text{C=O}$ $\quad \quad \quad \text{HC=CH}_2$ </p>	<p>Esterification reaction</p>  <p>+ By sonicating in a mixture (7:3) of HNO₃ and H₂SO₄</p> <p>+ Acryl chloride</p> <p> $\text{CNT} - \text{C}(=\text{O})\text{O}-\text{C}(=\text{CH}_2)\text{CH}_3$ </p>
Component		<p>-Copolymerizable photo initiator</p>  <p>R = Acryl</p>

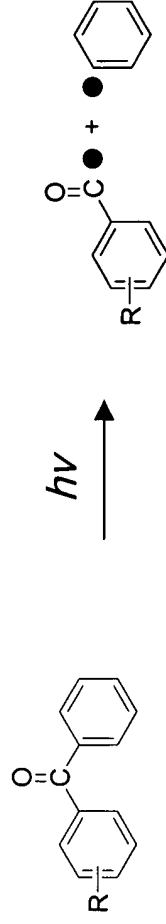
Comparison US 5,561,026 with 10/713,254

	US 4,439,291	10/713,254
Photosensitive compound	<p>-One acryloyloxy or methacryloyloxy group</p>   	<p>Copolymerizable photo initiator</p>   <p>R = Acryl</p>  

Copolymerizable photo initiator

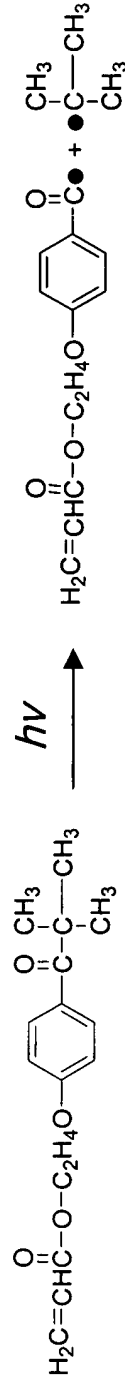


Radical Radical + Monomer



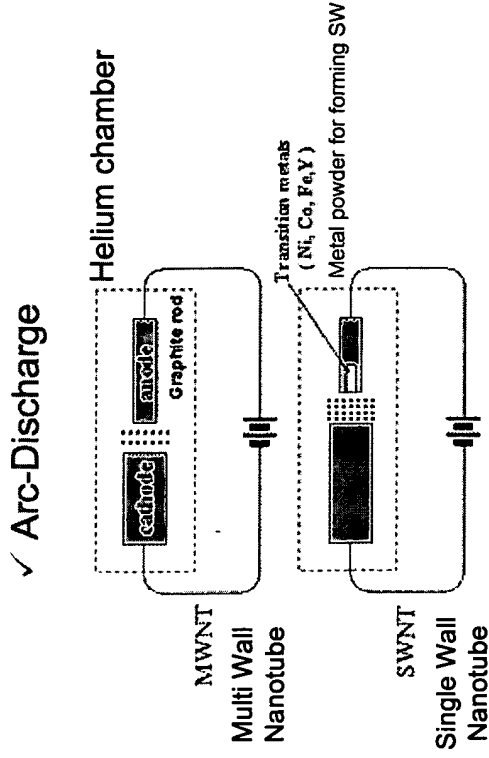
R = Acryl

Radical Radical
+ Monomer

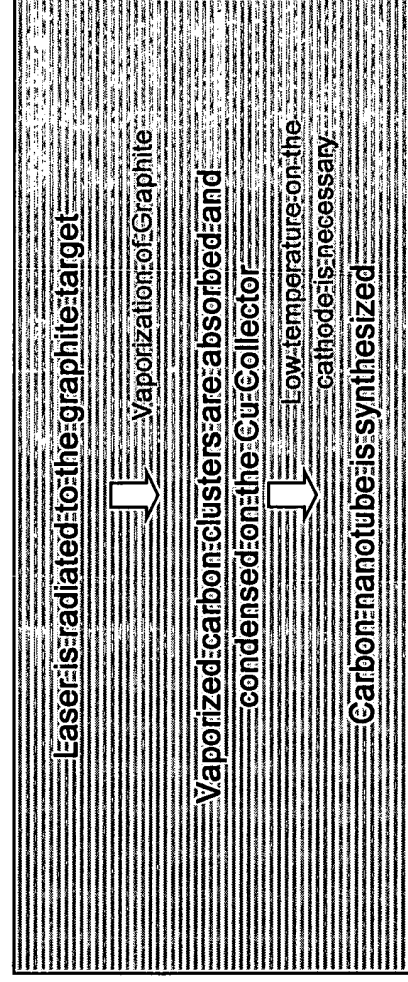
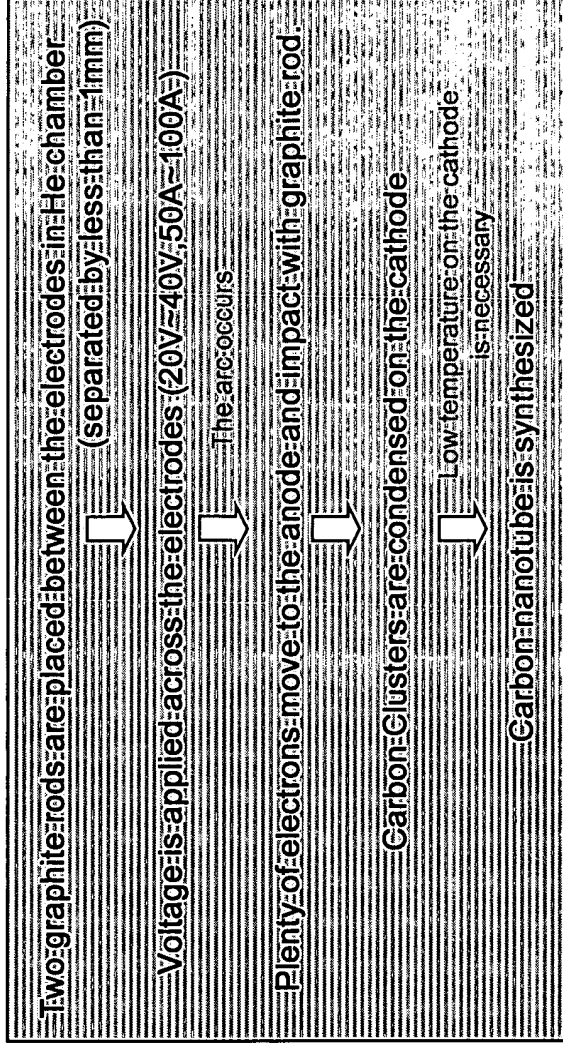
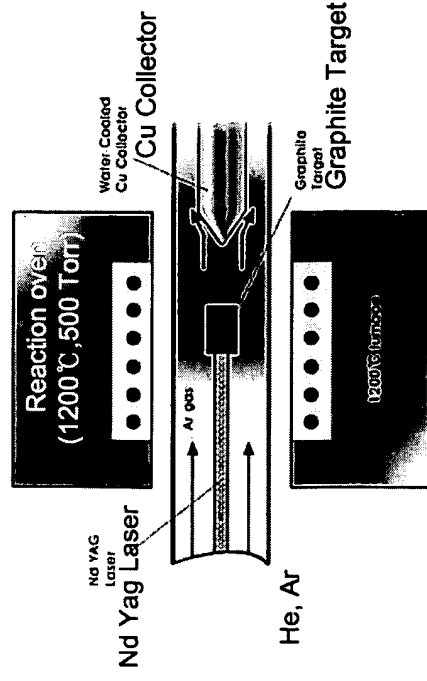


Radical + Monomer Radical

□ Synthesis of Carbon Nanotube used in the invention (1)

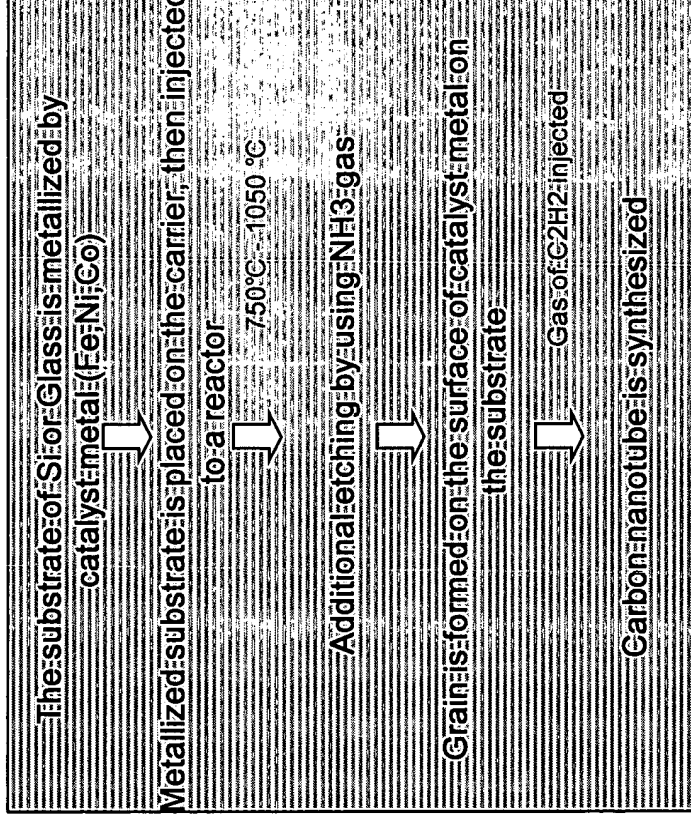
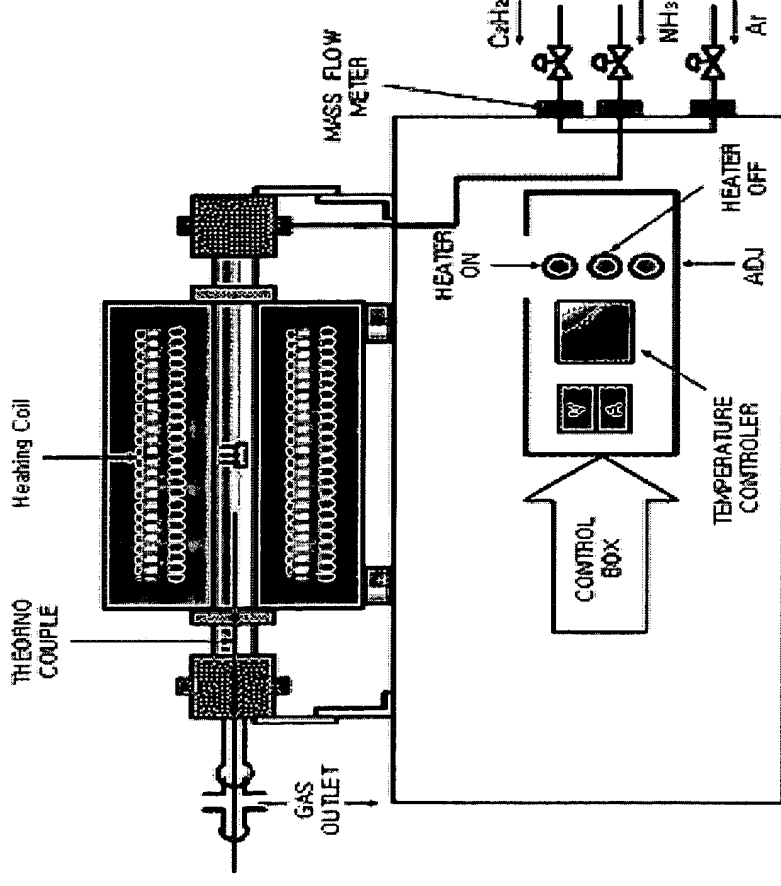


✓ Laser Ablation (Laser Vaporization)



□ Synthesis of Carbon Nanotube used in the invention (2)

✓ CVD, Chemical Vapor Deposition



- Carbon nanotubes grow on the grain formed after etching
- Grain : Embossing type of surface

□ Synthesis of Carbon Nanotube used in US 20010050219A1

✓ Low pressure with carboniferous liquid state

Summary

1. Differences with US 5,561,026
 - Fullerene is ball-type of carbon allotrope, which is surface-modified by additional reaction
 - CNT is nanotube-type and it can be acid-functionalized and shortened, forming COOH at both sides
 - Photosensitive groups are introduced on the surface by esterificating COOH and Acrylchloride
 - A photoinitiator in the composition is used, forming radicals and making UV-reaction easy. It is also involved in photopolymerization as a monomer to increase efficiency.
2. Differences with US 4,439,291
 - copolymeric photoinitiator is copolymerized with CNT substituted with photosensitive group.
3. Differences with US 20010050219A1
 - The invention can substitute all the surface of carbon nanotubes, so does not depend on the characteristic of each carbon nanotube produced by different methods. As a result, there is no relation to the invention.

Conclusions

Difference	US 4,439,291	10/713,254
Photosensitive Compound	-One acryloyloxy or methacryloyloxy group	-Photosensitive CNT $\text{CNT}-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-\overset{\text{O}}{\text{C}}-\underset{\text{CH}}{\text{CH}_2}$ -Copolymerizable photo initiator -Copolymerizable monomer or oligomer
Difference	US 5,561,026	10/713,254
Surface Modification Method	-Addition reaction $\text{C60}-\underset{\text{HC}=\text{CH}_2}{\overset{\text{C}=\text{O}}{\text{NCH}_2\text{CH}_2\text{CH}_3}}$	-Esterification reaction $\text{CNT}-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-\overset{\text{O}}{\text{C}}-\underset{\text{CH}}{\text{CH}_2}$
Difference	US20010050219A1	10/713,254
CNT Making Method	-Low pressure with carboniferous liquid state	-Arc-Discharge -Laser Vaporization -CVD, Chemical Vapor Deposition